National Aeronautics and Space Administration

NASA's Space Launch System: A New National Capability

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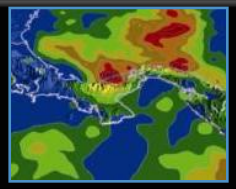
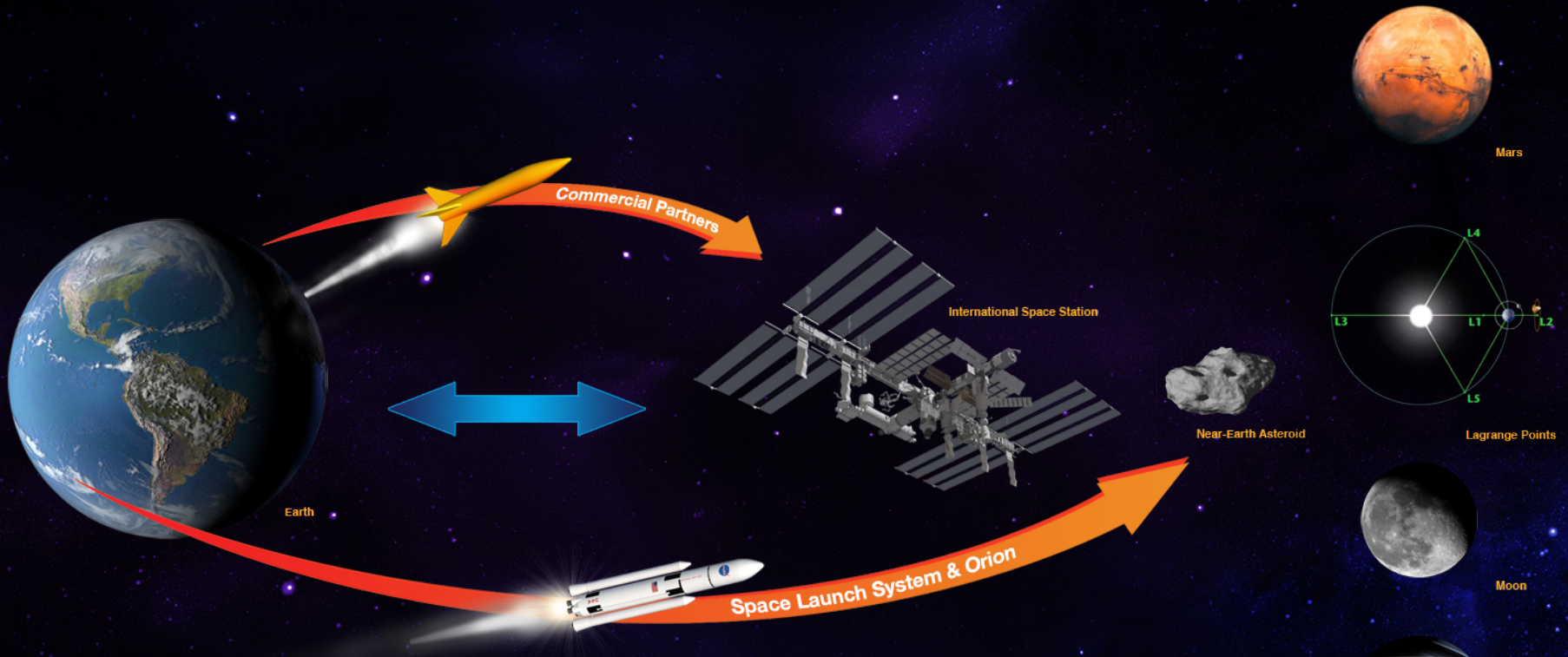
Space Launch System Program
NASA Marshall Space Flight Center
March 2012



Space Launch System

www.nasa.gov

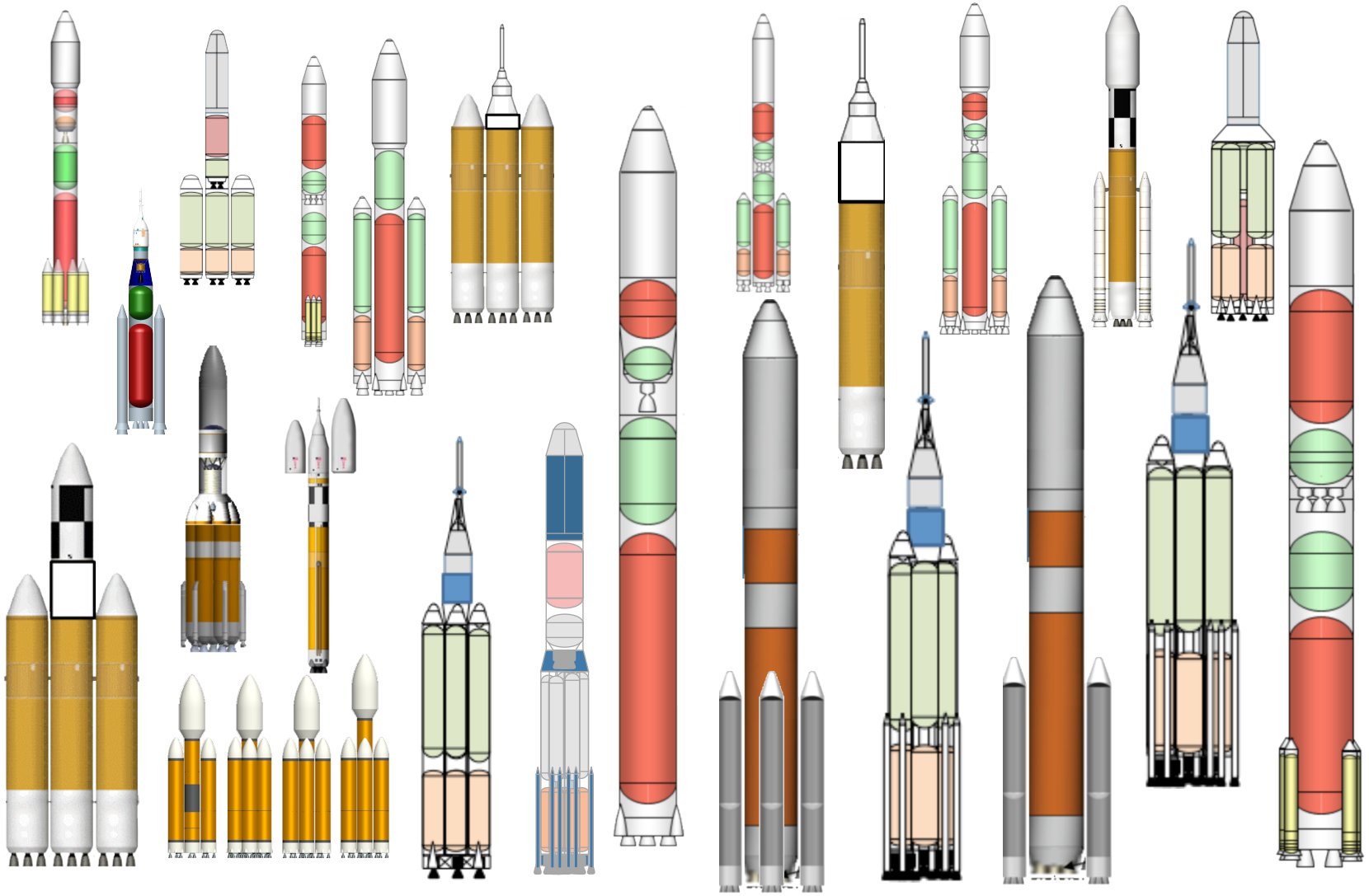
The Future of Exploration



My desire is to work more closely with the human spaceflight program so we can take advantage of synergy…. We think of the SLS as the human spaceflight program, but it could be hugely enabling for science.

— John Grunsfeld, Associate Administrator
NASA Science Mission Directorate
Nature, Jan 19, 2012

Many Solutions, One Affordable Answer



"This enterprise is not for the faint of heart."

—Wayne Hale, *former Space Shuttle Program Manager*

SLS Driving Objectives

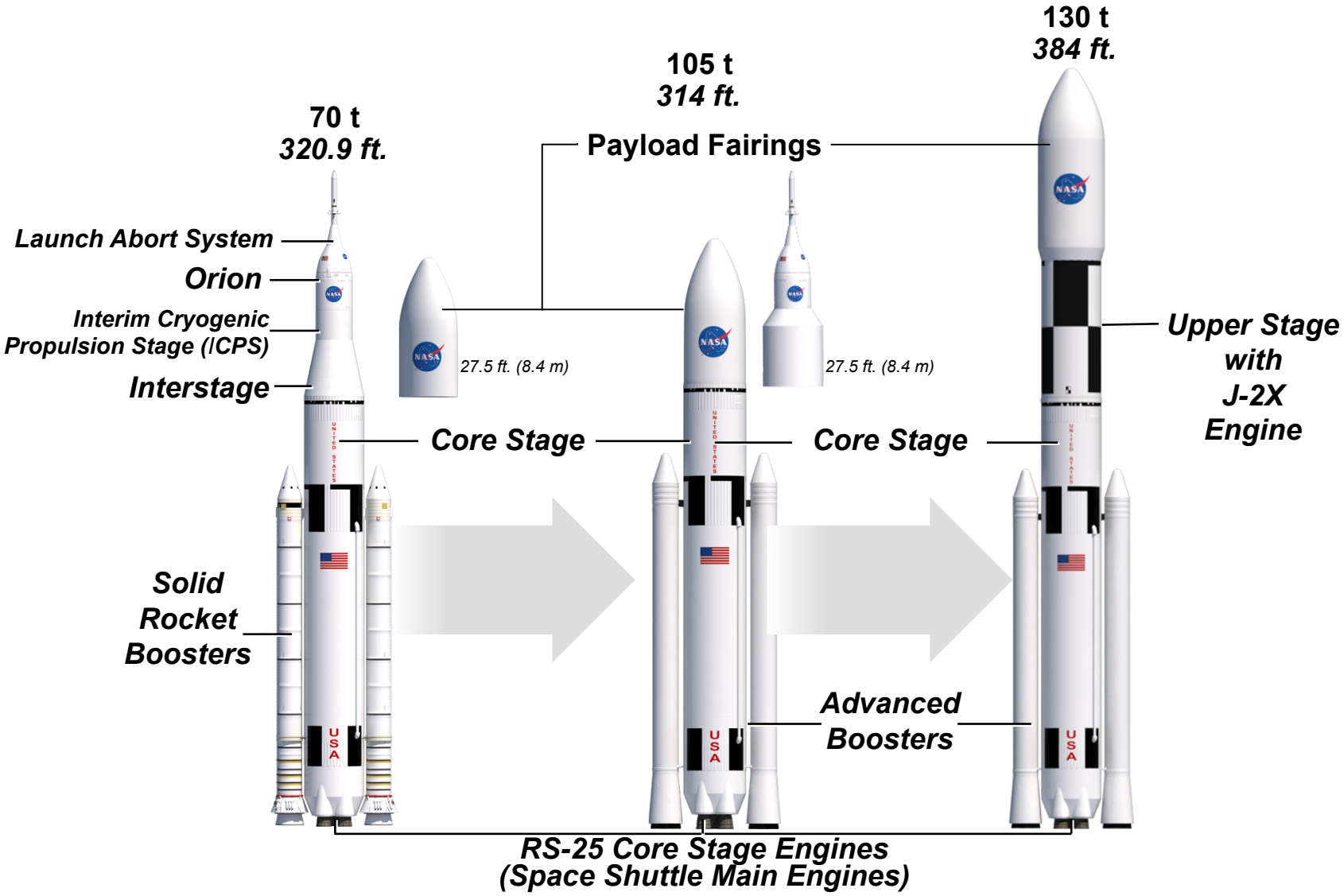
- **Safe: Human-Rated**

- **Affordable**
  - Constrained budget environment
  - Maximum use of common elements and existing assets, infrastructure, and workforce
  - Competitive opportunities for affordability on-ramps

- **Sustainable**
  - Initial capability: 70 metric tons (t), 2017–2021
    - Serves as primary transportation for Orion and exploration missions
    - Provides back-up capability for crew/cargo to ISS
  - Evolved capability: 105 t and 130 t, post–2021
    - Offers large volume for science missions and payloads
    - Modular and flexible, right-sized for mission requirements

Flexible Architecture Configured for the Mission

SLS Architecture Block Upgrade Approach



Starting with Available Assets and Evolving the Design

Assets in Inventory and Testing in Progress

First Flight 2017

SLS Affordability Begins with Accountability

- **Evolvable Development Approach**
  - Manage requirements within constrained, flat budgets.
  - Leverage existing National capabilities, including LOX/LH_2 propulsion infrastructure, manufacturing facilities, and launch sites.
  - Infuse new design solutions for affordability.
- **Robust Designs and Margins**
  - Trade performance for cost and schedule.
  - Use heritage hardware and manufacturing solutions.
  - Maintain adequate management reserves controlled at lower levels.
- **Risk-Informed Government Insight/Oversight Model**
  - Insight based on:
    - Historic failures.
    - Industry partner past performance and gaps.
    - Complexity and design challenges.
  - Judicious oversight:
    - Discrete vs. near-continuous oversight.
    - Timely and effective decisions.
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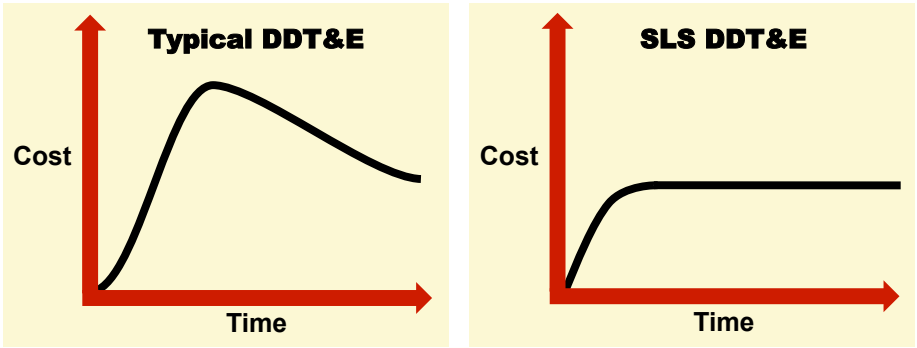
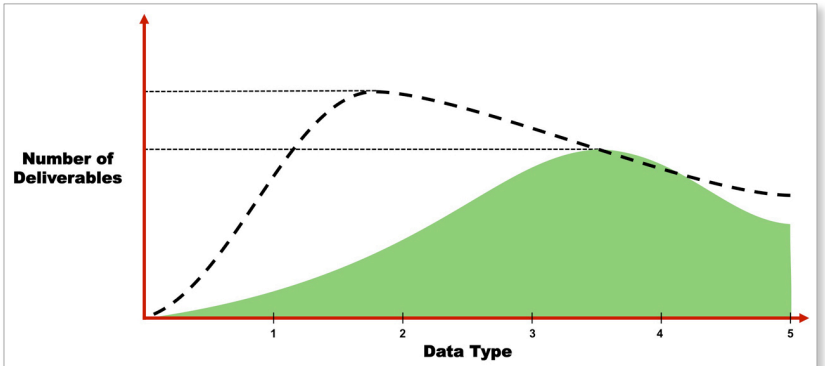
- **Right-Sized Documentation and Standards**
  - Up to 80% reduction in the number of Data Requirement (DR) and Program documents from the Ares Projects.
  - Industry practices and tailored NASA standards.
- **Lean, Integrated Teams with Accelerated Decision Making**
  - Simple, clear technical interfaces with contractors.
  - Interconnected Systems Engineering & Integration (SE&I) organization.
  - Empowered decision makers at all levels.
  - Fewer Control Boards and streamlined change process.



Sustainability Through Life-Cycle Affordability

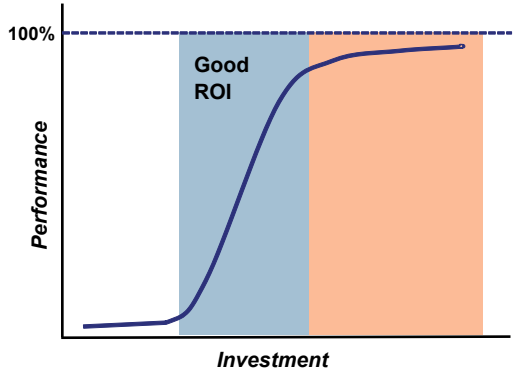


Focuses on the Data Content and Access to the Data

Affordability: The ability to develop and operate the SLS within the National means, to sustain funding for the Program.

Cost is a Function of Performance

- Extreme requirements drive up costs by 215%.
- Question: Is a 14% increase in maximum speed (performance) *worth* a 215% increase in cost?
- Question: Is a 28% increase in 0 – 60 mph acceleration (performance) *worth* a 215% increase in cost?



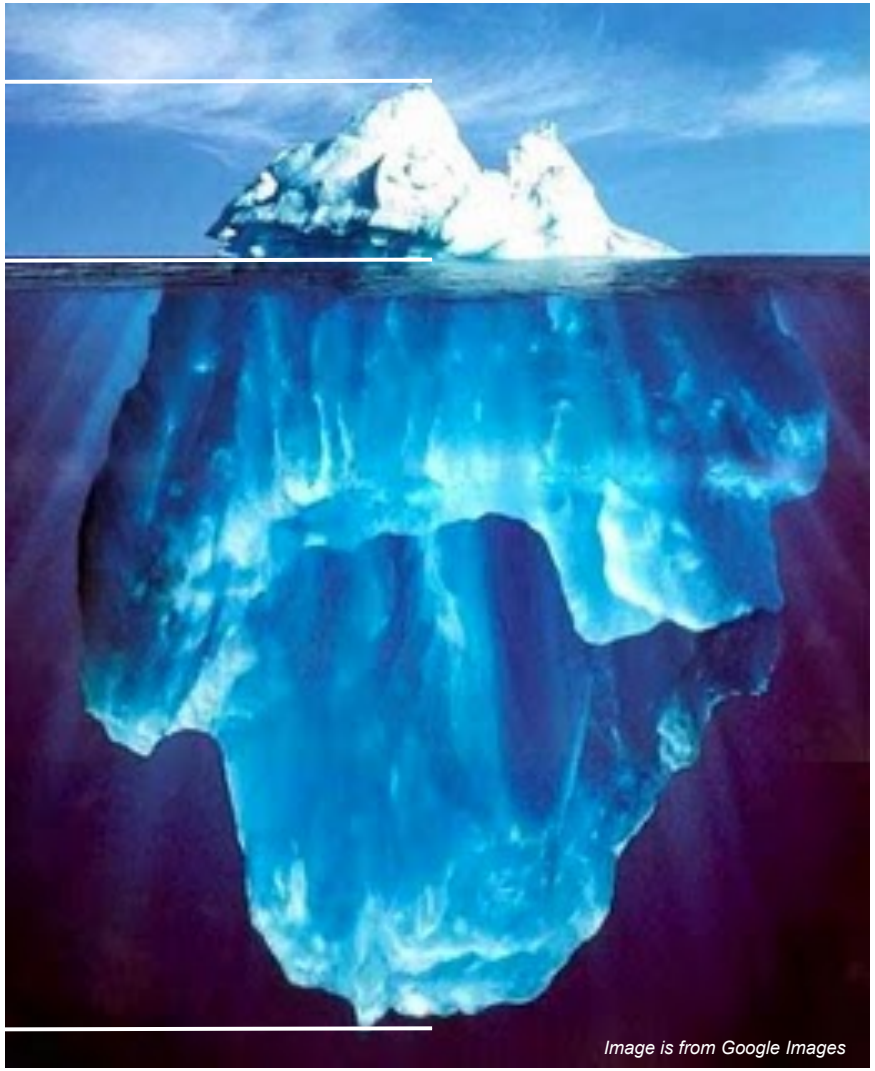
	Porsche 911 Carrera	*Porsche 911 Turbo*	*Porsche 911 GT2 RS*
Cylinders	6	6	6
Engine layout	Rear	Rear	Rear
Performance	180 mph	195 mph	205 mph
0-60 mph	4.7 sec	3.5 sec	3.4 sec
MSRP	$77,800	$160,700	$245,000
Horsepower	*345*	*530*	*620*

— Source: Porsche website

We Will Factor the *Real* Cost into Our Decisions

The *Real* Cost of Launch Vehicle Development

- **Affordability requirements demand that we develop the SLS in a faster and more efficient manner, including the decision-making process.**
- **We cannot afford to delay decisions … or delay getting behind them!**

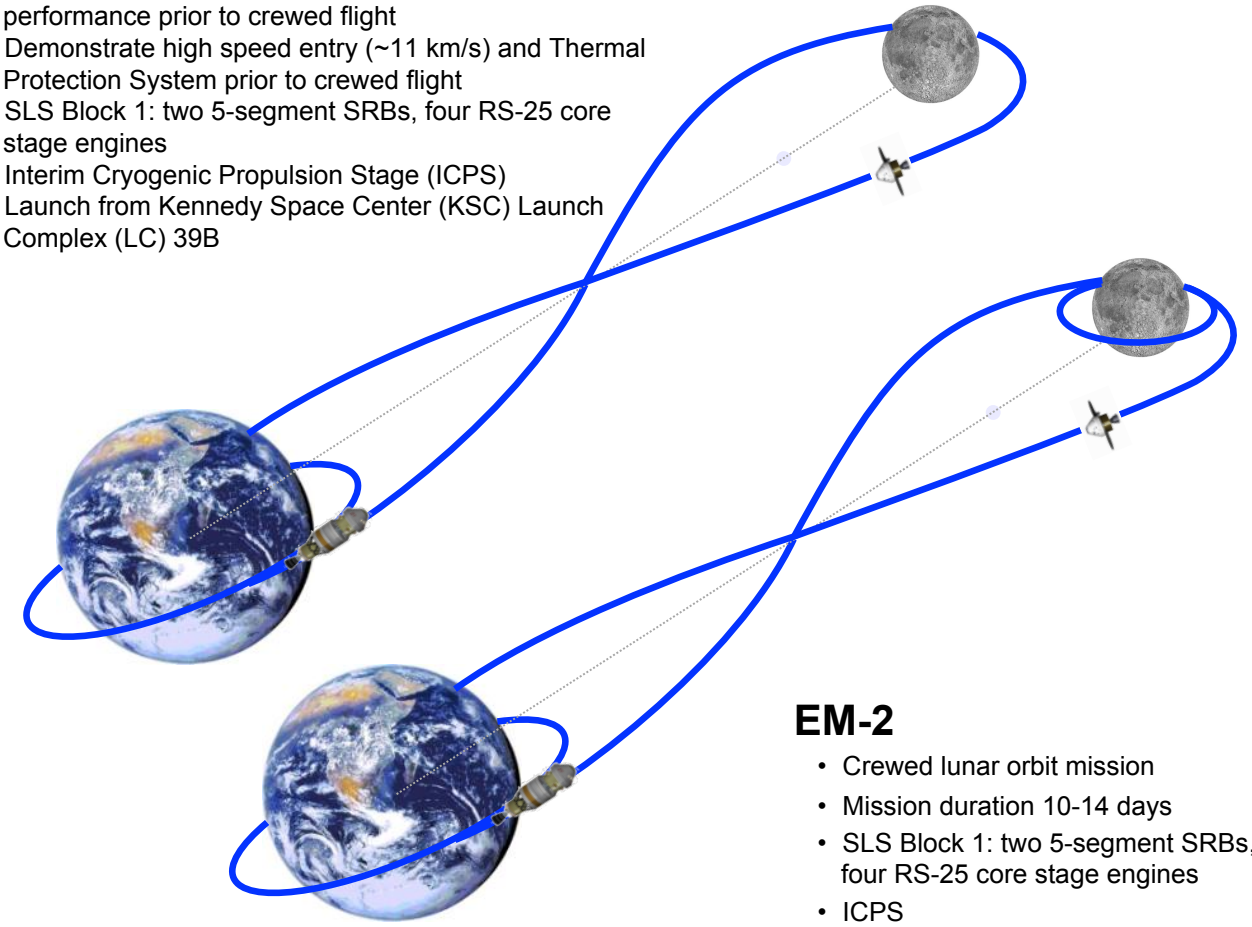


Time Is The One Resource That We Can Never Regain

Initial Exploration Missions (EM)

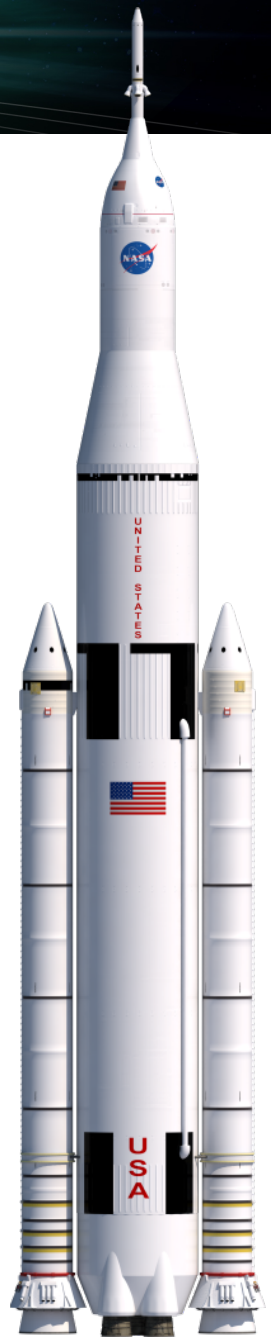
EM-1

- Un-crewed circumlunar flight – free return trajectory
- Mission duration ~7 days
- Demonstrate integrated spacecraft systems performance prior to crewed flight
- Demonstrate high speed entry (~11 km/s) and Thermal Protection System prior to crewed flight
- SLS Block 1: two 5-segment SRBs, four RS-25 core stage engines
- Interim Cryogenic Propulsion Stage (ICPS)
- Launch from Kennedy Space Center (KSC) Launch Complex (LC) 39B



EM-2

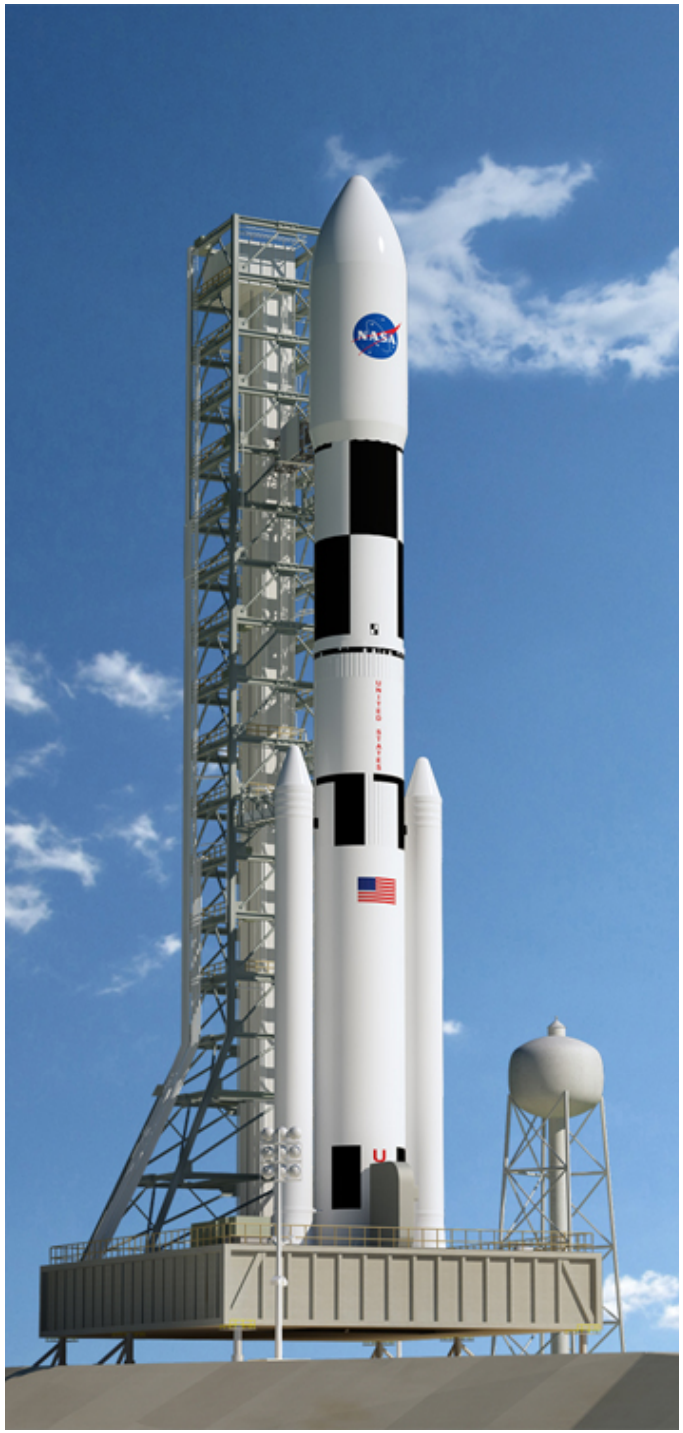
- Crewed lunar orbit mission
- Mission duration 10-14 days
- SLS Block 1: two 5-segment SRBs, four RS-25 core stage engines
- ICPS
- KSC LC 39B



NASA's Space Launch System Summary

- **Vital to NASA's exploration strategy and the Nation's space agenda.**
- **Key tenets: safety, affordability, and sustainability.**
- **System Requirements Review/System Definition Review in progress.**
- **Prime contractors on board, engaging the U.S. aerospace workforce.**
- **RS-25 core stage engines positioned for integration and testing with the core stage.**
- **Five-segment solid rocket booster and J-2X upper stage engine testing in progress.**
- **Competitive opportunities for innovations that affordably upgrade performance.**
- **On track for first flight in 2017.**

For More Information



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